

# MANUFACTURING METHOD OF BELT AND MANUFACTURING APPARATUS

## BACKGROUND OF THE INVENTION

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### Field of the Invention

**[0001]** The present invention relates to a manufacturing method of belts applicable to intermediate transfer belts or fixing belts for copying machines, printers and so forth, and relates to a manufacturing apparatus of these belts.

### 10 Brief Description of the Related Art

**[0002]** In electro-photographic copying machines and printers, belts are

**[0003]** used for transferring or fixing toners. Usually, these belts are formed out of resins with a low stretchability and sometimes they bear coated layers.

**[0004]** Since the above-mentioned conventional belts are usually formed out of  
15 only resins with no elastic layers, their shapes and sizes are limited, consequently, their applicable areas are limited.

## SUMMARY OF THE INVENTION

**[0005]** The present invention is carried out in view of the above-mentioned  
20 problems and its objective is to provide the manufacturing method of belts having no limitations in their shapes and sizes, but with high quality, and also to provide the manufacturing apparatus of them.

**[0006]** The manufacturing method and apparatus of belts according to the present invention are arranged as follows.

**[0007]** (1) A manufacturing method of a belt comprising steps of: forming a solid rubber into a sheet form; adhering the solid rubber sheet to a substrate with small stretchability so as to form into a laminated film; and forming the laminated film into a seamless cylinder so as to be formed in one piece.

5 **[0008]**(2) A manufacturing method of a belt comprising steps of: forming a solid rubber into a sheet form; forming the solid rubber sheet and a seamless substrate film into a laminated cylindrical shape; placing the laminated cylinder between an outer casing mold and a core mold where either of the solid rubber sheet or the seamless substrate film is facing inside; and applying a pneumatic pressure to said laminated cylinder for vulcanizing said solid rubber sheet and for adhering the solid rubber sheet to the substrate so as to form said laminated cylinder in one piece.

**[0009]**(3) The manufacturing method of the belt according to (1) or (2) wherein a coated layer is formed on the outer surface of said belt.

15 **[00010]**(4.) A manufacturing apparatus of a belt comprising: a cylindrical outer casing mold; an inner core mold; an air bag for applying a pneumatic pressure to a laminated cylinder comprising a solid rubber and a seamless substrate from the outside of the core mold; and a vulcanizing room for vulcanizing the cylindrical solid rubber and for adhering the cylindrical solid rubber to the cylindrical substrate so as to form the laminated cylinder in one piece.

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## BRIEF DESCRIPTION OF DRAWINGS

[00011]FIG.1 is a cross-sectional view showing an outline arrangement of a vulcanizing apparatus according to an embodiment of the present invention.

5 [00012]FIG.2 is a perspective view illustrating a state where both ends of a rubber sheet and a seamless resin film are laminated and butted so as to be formed one piece cylindrical body.

[00013]FIG.3 is a flow chart showing a manufacturing process of the embodiment.

10 [00014]FIG.4 is a chart showing characteristic data of a product according to the present embodiment.

[00015]FIG5 shows cross-sectional views of belts according to the present embodiment.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

15 [00016]Hereinafter the embodiment according to the present invention is described by referring to drawings. In the present embodiment, the manufacturing method and apparatus of intermediate transfer belts and fixing belts used in color copying machines, color printers and the like are explained.

20 [00017]FIG.1 is the cross-sectional view showing the outline arrangement of the vulcanizing apparatus used in manufacturing the belt according to the present embodiment.

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ay* [00018]In the figure, reference numerals "1" is a base plate placed on the bottom of the apparatus, "2" is an outer casing mold as a cylindrical outer die and "3" is a

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core mold as an inner die. A reference numeral "4" is an air bag for applying a pneumatic pressure from outside of the core mold 3 to an unvulcanized rubber 5 as a cylindrical solid sheet and a rein film 6 as a cylindrical seamless sheet base, arranged between the outer casing mold 2 and the core mold 3. A reference numeral "7" is a vulcanizing room for vulcanizing the unvulcanized rubber 5 and adhering it to the rein film 6 so as to be formed in one piece by applying the pneumatic pressure from the air bag 4.

**[00019]** In the present embodiment, the resin film 6 with low elasticity, namely, not stretchable or hard to stretch, is used as a substrate and rubber elastic layers are applied to either the outer side, the inner side or both sides of the resin film, consequently to be formed in one piece. The solid rubber is used for these elastic layers, but liquid or paste rubber is not used for these elastic layers. The applied pneumatic pressure generated by expanding the air bag 4 forms the solid rubber and the resin film into one piece.

**[00020]** The unvulcanized rubber 5 precisely formed in a sheet form by calender rollers and the like is used as a substrate for the belt. Since the vulcanized rubber belt bears smooth surfaces attributed to the forming method, the belt is employable without polishing. And a dispersion value in the thickness of the belt can be kept less than 0.4mm.

**[00021]** A manufacturing procedure of the intermediate transfer belt is explained step by step by referring to a process chart shown in FIG.3.

(Step S1) A CR rubber is formed into a sheet by calender rollers. Dimensions of the sheet, for example, are as follows. Width: 400mm. Thickness:  $0.48 \pm 0.02$ mm.

5 (Step S2) The sheet rubber is cut in a predetermined length, for example, 528 $\pm$ 1mm.

(Step S3) The cut rubber sheet and a seamless film are laminated and both cut ends of cut rubber sheet are butted together with a seamless film so as to form a cylindrical shape. A distance t between both ends of the rubber sheet is kept 0 to 2mm as shown in FIG.2 so as to keep uniform thickness all over the cylindrically  
10 shaped rubber sheet.

(Step S4) The butted cylindrical unvulcanized rubber is placed in the vulcanizing apparatus shown in FIG.1 and vulcanized.

(Step S5) Outer surface of the vulcanized cylindrical rubber is coated by spraying a fluoride coating material with thickness by 6  $\mu$ m and baked.

15 (Step S6) Both ends of coated and baked cylindrical rubber is trimmed, thus the intermediate transfer belt with predetermined dimensions is obtained.

**[00022]** Properties of the belt obtained by the above-mentioned procedure are shown in FIG.4.

**[00023]** The present embodiment can provide the belt with high quality without  
20 any limitations in its shape and dimension.

**[00024]** Any seamless film can be used as the substrate without any limitations in materials and dimensions. A plain weave fabric can also be used as the

substrate in place of the resin film. Any rubber material can be used as a sheet material for the belt.

**[00025]** The vulcanizing apparatus is capable of manufacturing belts (a) to (d) depicted in FIG.5. In belt (a) a rubber layer is arranged at the outside of the belt.

5 In belt (b) a rubber layer is arranged at the inside of the belt. In belt (c) rubber layers are arranged at both sides of the belt. The apparatus is also capable of manufacturing belt (d) formed out of only the rubber.

**[00026]** As explained above, the present invention can easily provide the belt with high quality without any limitations in its shape and dimension.